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Floating floors-a demystification

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Generally floating floors can be used to obtain living- and work space comfort in noisy and vibrating environments (-> at the reception side), or just to realise a reduction of noise and vibration disturbance into the environment (-> at the source). They are integrated into discotheques, technical floors, recording studios, factories, apartment blocks, etc.

In order to achieve a better understanding in the factors influencing the acoustical behaviour of the floating floor system, CDM has been testing different isolation systems in its own newly-built test lab: from surface mats to discrete bearings systems. The constitution of the tested floors is principally based on the isolation systems frequently described by acoustical engineers and installed by CDM during the past years. The tests were carried out in cooperation with the technological institute "DE NAYER" (Mechelen - Belgium), and with supervision of independent acoustical engineers.

This article presents the descriptions and conclusions of the first test phase (nov. 1996 - march 1997).

Influencing factors tested:

- the suspension mode: surface mats versus discrete bearings
- the (dynamic) stiffness of the discrete bearings
- the quantity and quality of absorption material between the discrete bearings
- the thickness of the free air void between the discrete bearings

Characteristics of the test rooms and floors:

- rooms:
  - send: interior dimensions: 304x304x250 (cm) / wall constitution: wooden structure + mineral wool + wooden and gypsum covering panels at the inside and at the outside
  - receive: interior dimensions: 1076x560x247 (cm) / wall constitution: heavy masonry

- floors:
  - structural basic floor: 1076x560 (cm) concrete slab of 21cm
  - floating floor: 300x300 (cm) concrete slab of 12cm

The send room is equiped with a handling system allowing for raising, lowering and moving it over the floating floor, which itself can also be raised and lowered, so to replace easily the acoustic isolation. Mineral wool is installed along the perimeter of the floating slab in order to realise on the one hand a total decoupling from the walls of the removable acoustic booth, and on the other hand the tightness of the floor isolation.

Testing devices and conditions:

Tests were carried out using a standardised impact machine (Bruel & Kjaer type 3204) and a standardised sound source (Bruel & Kjaer type 1405) to measure impact and airborne noise levels by means of a standardised sonometer (CEL 93 - microphone CEL 250), following ISO 140/4, ISO 140/7, ISO 717/1, ISO 717/2. A standardised level recorder (Bruel & Kjaer type 2305) was used to monitor eventual peak levels, influencing the test validity. The validity of any carried-out test is besides also determined theoretically: $Rw + Ln = 44 + 30Log(f) - 10Log(\sigma)$ = constant for all tested floors.

Tested floors:

1-1. CDM-ISO-FLOAT with 5x5 discrete bearings CDM-33060, dimensions 60x60x60 (mm) at 1080N/bearing -> f_{res} = 8Hz, glued to the formwork panel OSB (wood) 3000x3000x18 (mm)
1-2. Plus an absorption layer of 40mm mineral wool (density 18kg/m^3) in-between the discrete bearings
1-3. Plus an overheight of 28mm in fibrocement VIROC (dim. 90x90x28mm), glued to the bearings
1-4. Plus a second absorption layer of 40mm mineral wool (density 18kg/m^3) glued to the first layer

2-1. CDM-ISO-FLOAT with 3x3 discrete bearings CDM-81060, dimensions 60x60x60 (mm) at 3000N/bearing -> f_{res} = 5Hz, glued to the formwork panel OSB (wood) 3000x3000x18 (mm)
2-2. Plus an absorption layer of 40mm mineral wool (density 18kg/m^3) in-between the discrete bearings
2-3. Plus an overheight of 28mm in fibrocement VIROC (dim. 90x90x28mm), glued to the bearings
2-4. Plus a second absorption layer of 40mm mineral wool (density 18kg/m^3) glued to the first layer

3-1. CDM-ISO-FLOAT with 5x5 discrete bearings CDM-Helivibram (steel spring with a CDM jacket), dimensions 100x100x120 (mm) at 1080N/bearing -> f_{res} = 4Hz, glued to the formwork panel OSB (wood) 3000x3000x18 (mm)
3-2. Plus an absorption layer of 40mm mineral wool (density 18kg/m^3) in-between the discrete bearings
3-3. Plus a second absorption layer of 40mm mineral wool (density 18kg/m^3) glued to the first layer

4-1. CDM-ISO-FLEX consisting of 5 bearings Flexamor A2 at 5400N/bearing -> f_{res} = 9Hz, installed in a layer of 2 x 40mm mineral wool (density 32kg/m^3)
4-2. CDM-ISO-FLEX consisting of 5 bearings CDM-81060 (dim. 70x70x60mm) at 5400N/bearing -> fres = 5Hz, installed in a layer of 2 x 40mm mineral wool (density 32kg/m^3)

5-1. Surface mat ISOLGOMMA (recycled rubber) 2 x 10mm at 3000N/m^2
5-2. Surface mat AGGLOFOAM (recycled PUR) 40mm at 3000N/m^2

- The following table gives the global classification of the tested floors based upon the calculated ISO - number (single-value) for impact and airborne noise isolation:

TYPE	ISO air	nr.	ISO impact	nr.	ISO total	nr.
3-2	80	1	99	1	179	1
3-3	80	1	99	1	179	1
2-2	78	2	98	2	176	2
1-4	77	3	96	4	173	3
1-2	76	4	96	4	172	4
4-2	75	5	97	3	172	4
2-4	73	6	98	2	171	5
3-1	76	4	95	5	171	5
2-1	77	3	93	6	170	6
5-2	77	3	92	7	169	7
1-3	76	4	90	8	166	8
2-3	70	8	96	4	166	8
1-1	72	7	93	6	165	9
4-1	69	9	92	7	161	10
5-1	72	7	78	9	150	11
Naked floor	55	10	54	10	109	12

Conclusions

- the suspension mode: on the level of airborne noise isolation no important difference can be made between surface mats and discrete bearings systems with equal dynamic stiffness characteristics. On the contrary, on the level of impact noise isolation the discrete bearings system performs significantly better.
- the stiffness of the discrete bearings: generally we can say that a lower resonance frequency for a discrete bearing clearly results in a higher performance on all levels. However take notice of the fact that on the level of airborne noise isolation the CDM-81060 (High Resilience Material) stays very close to the steel spring element, whereas on the level of impact noise isolation the CDM-81060 sticks to the CDM-33060 (Classic Elastomer), resulting in a loss of performance when compared to the steel spring.
- the absorption material: as a result of the tests we recommend that the space between the bearings is best completely filled by absorption material with an open cell structure. However, the absorption layer should not be put under compression, so to allow still for free movement of the air present in the cells. On the level of impact noise isolation, lower densities for the absorption layer seem to perform better, and the inverse is true for the airborne noise isolation.
- the thickness of the free air void: appearantly the free air void thickness should be limited to a maximum of 20% of the total isolation thickness.

Bibliography

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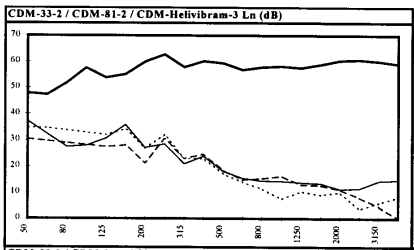
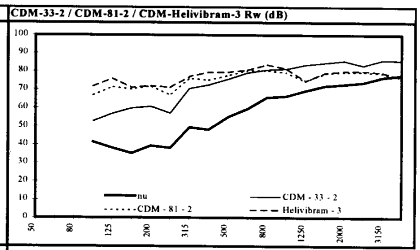
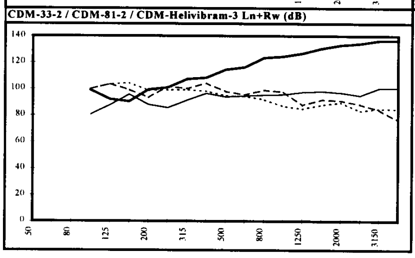
- “Cursus Bouwakoestiek voor Burgerlijk Ingenieurs” (Prof. Dr. Ir. G. Vermeir, 1990)
- “Noise Control in Building Services” (Sound Research Laboratories Ltd, 1988).

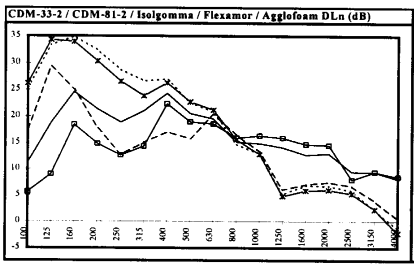


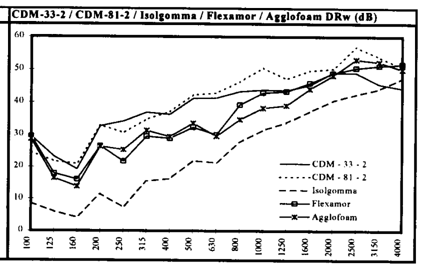


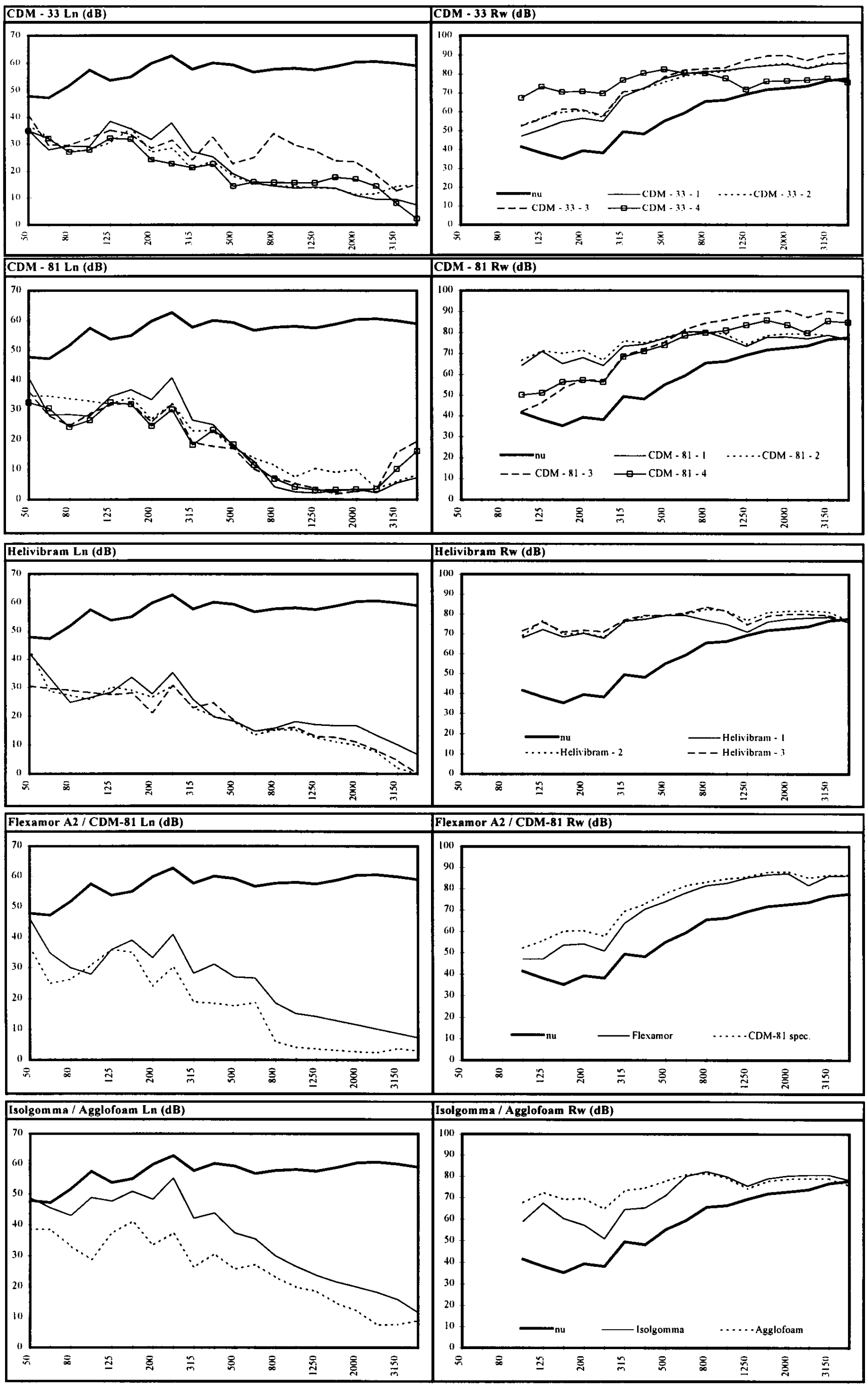


The two graphs above show the comparison between three types of bearings with respect to the naked floor "nu" on the level of impact noise level Ln and airborne noise isolation Rw in dB. The graph left gives the validity range of the tests as the sum Ln+Rw must be constant for all floor systems: between 100 and 500Hz. This validity range can be taken more globally for the other tests as well.

The two graphs below give a global comparison between frequently used floor systems, relative to the naked floor






CDM - 33 Ln (dB)
CDM - 33 Rw (dB)
nu
CDM - 33 - 1
CDM - 33 - 2
CDM - 33 - 3
CDM - 33 - 4
CDM - 81 Ln (dB)
CDM - 81 Rw (dB)
nu
CDM - 81 - 1
CDM - 81 - 2
CDM - 81 - 3
CDM - 81 - 4
Helivibram Ln (dB)
Helivibram Rw (dB)
nu
Helivibram - 1
Helivibram - 2
Helivibram - 3
Flexamor A2 / CDM-81 Ln (dB)
Flexamor A2 / CDM-81 Rw (dB)
nu
Flexamor
CDM-81 spec.
Isolgomma / Agglofoam Ln (dB)
Isolgomma / Agglofoam Rw (dB)
nu
Isolgomma
Agglofoam